Radio Communications for Labrador Sea AOSN 1998 Deployment

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LONG-TERM GOALS

The overall goal of the Labrador Sea AOSN project is to create and demonstrate a reactive survey system, capable of long-term, unattended deployments in harsh environments. More specifically, with regard to the communications component of the effort, our goal is the exploitation of bi-directional satellite based systems to control and retrieve data from ocean sampling systems.

OBJECTIVES

The objective of this component of the program is to provide the hardware and software means for multiple methods of communications with the AUV docking controller on the AUV mooring(s) to be deployed in the Labrador Sea in early 1998. A critical feature of the project is the need for a satellite based, 2-way system for near realtime data retrieval and parameter control from shore. A secondary but necessary practical requirement is the need for a simple, reliable bi-directional link from a nearby ship to both the communication controller (COMCON) in the mooring surface buoy and the docking controller (DOCCON) at the AUV dock site on the mooring.

APPROACH

The need for a reliable means of communicating with the AUV mooring system is important not only throughout the 3 month expected life of the autonomous test program but also during dock tests at home and during mooring installation. Our approach is to provide a system housed within the surface buoy on the S-tether style deep mooring that functioned primarily as a conduit for communication transactions between researchers and the DOCCON/AUV systems mounted on the mooring well below the surface. In order to minimze the impact of the actual communication hardware on the surface buoy, a modest PC104 based computer was included in the surface buoy package. Figure 1 shows in block detail the functions of the COMCON subsystem.

A simple transaction protocol was devised to allow COMCON/DOCCON communication over a 2-conductor, galvanically isolated RS485 link as part of the electro-mechanical cable

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between the surface buoy and the DOCCON 500m below.

The Labrador Sea site is too distant for any practical method of communication to shore other than a satellite based system. After a brief review of currently available systems, 2 were selected as candidates: Inmarsat-C and one of the emerging LEO systems, Orbcomm. Tests with the Orbcomm system and recognition of the short time available before this project must go forth with a demostrational system resulted in a decision to use the Inmarsat-C system to provide the shore-to-buoy link. It is recognized that this system is expensive (about $6.5 per kilobyte) however it does have the attribute of being established, reliable and fairly convenient to use over the internet email system.

Other means of local communication and control have been included that employ radio for short range line-of-sight use during testing and deployment.

WORK COMPLETED

An electronics package has been designed and 1 unit built and tested as part of preparations for a test mooring deployment in October of this year. The suite of communication facilities consists of a Trimble Galaxy Inmarsat-C transceiver with GPS receiver, a FreeWave 900 MHz spread spectrum radio modem, a 2-ID Seimac Argos PTT, an auxiliary 455 MHz radio receiver using DTMF signalling to achieve a very reliable power cycling function on the COMCON computer, and a low power PC104 formfactor CPU stack with a number of individually controllable DC/DC power converters.

A PC104 compatible board was designed and fabricated to include some additional necesary functions including as a galvanically isolated RS485 interface, power control for sensors, wakeup and power cycling controls, watchdog timer, DTMF receiver, timebase and the means to monitor battery voltages. It has been decided to use this same board for wakeup functions in the DOCCON as well.

This electronics package along with a battery pack, a SeaBird SBE38 temperature sensor, a Parascientific 200m pressure sensor, and antennas is installed in a steel sphere surface buoy.

Software was written and integrated with software that runs on the DOCCON. Extensive testing of the RS485 link, Inmarsat link, radio modem link and Argos was performed on the bench, and during the test mooring deployment.

During the actual deployment of an S-tether style deep mooring such as used for this project, the surface buoy is submerged for a short period of time when the anchor falls to the bottom. Therefore we designed and tested the antennas to survive immersion to at least 100m depth. The Inmarsat antenna is contained within a 10” glass sphere held within the standard polyethylene “hardhat” with no noticable degradation of signal strength.

We have subscribed to standard Inmarsat-C service via internet email with some modifications to the normal messaging sequence since most of the time the buoy transceiver will be unpowered and therefore not able to respond to requests for traffic from the Inmarsat system. We have configured a method of internet email messaging via Comsat and the Inmarsat system which can be used to send & receive binary or ascii messages between shore and buoy without having to be concerned with the actual time that the buoy transceiver is on.

RESULTS

The COMCON package, complete with buoy housing and antennas was deployed during the October test cruise. At the time of the October test, the software associated with the Inmarsat-C link was not fully integrated with the COMCON code however standalone code was used to test messaging between buoy and shore. Bugs were found and have since been fixed. Otherwise, the COMCON buoy was successfully used as a serial link between the DOCCON and a shipboard console for purposes of monitoring the operation of the dock throughout the cruise. Many hours of autonomous operation were logged by the COMCON. The RS485 link between DOCCON and COMCON proved reliable. Data from the Argos PTT was sent and received successfully. The radio modem link performed well enough for connection to the ship in excess of 3nm range at 19200 bps.

The COMCON Inmarsat transceiver, requires as much as 130W when transmitting (120W for transceiver) from its battery pack. The projected use is 10Kbytes per day or about 4 min actual transmit time. Most of the time however, the entire system is off with wakeup caused by a number of conditions, the most likely of which are requests for attention from the DOCCON. Various means of power management are implemented to minimze the average power consumption. In addition, the Argos, Inmarsat, and main CPU stack have individual batteries to minimize the possibility of total system failure should one part of the system draw down its battery.

IMPACT/APPLICATIONS

Our intention is that this experience with Inmarsat-C will be a step forward in communication developments that will augment our ability to manage open ocean measurement systems.

RELATED PROJECTS

This project is part of the Multidisciplinary University Research Initiative: “Real-Time Oceanography with Autonomous Ocean Sampling Networks: A Center for Excellence”.

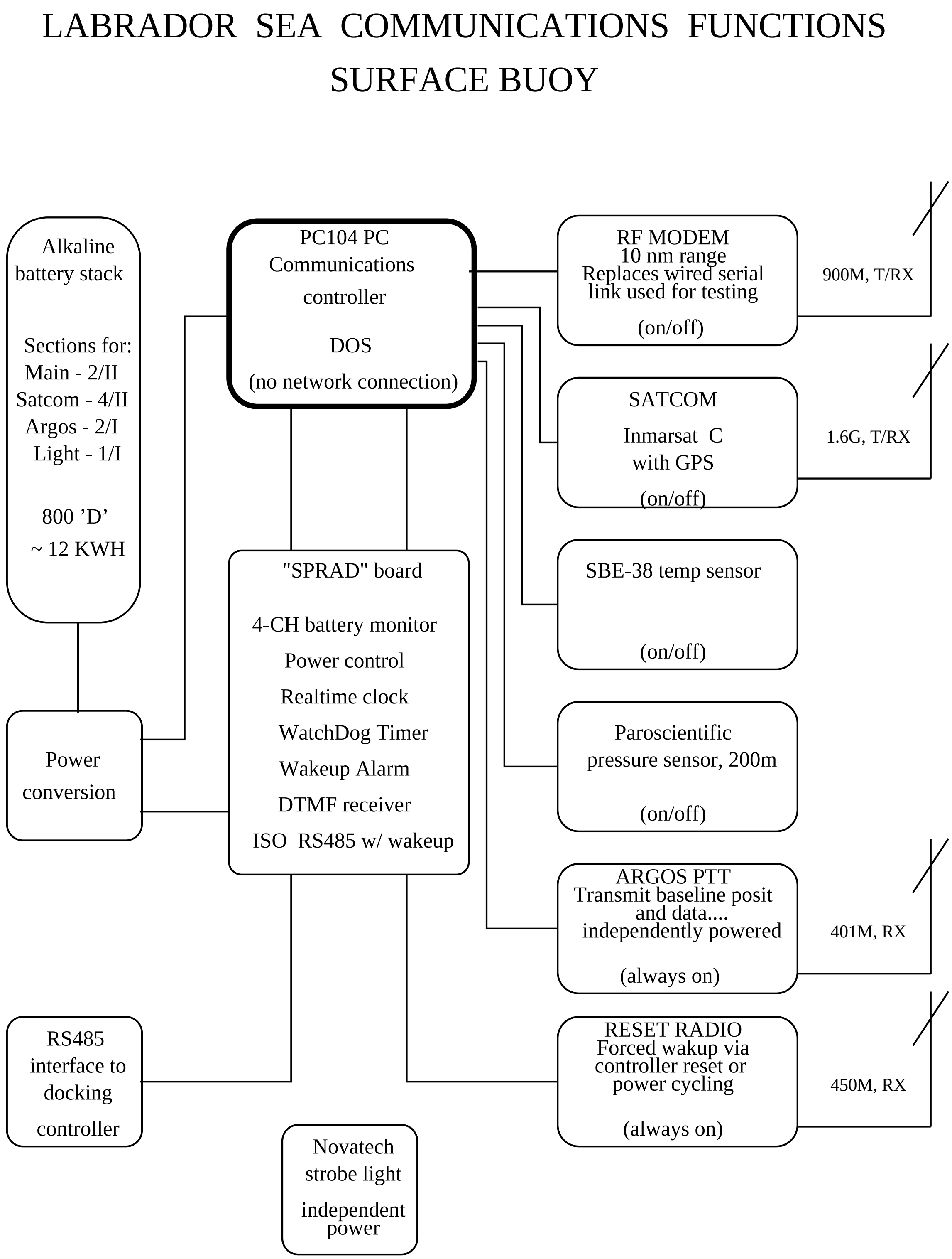

Figure 1: Labrador Sea AOSN Communications Controller Functions